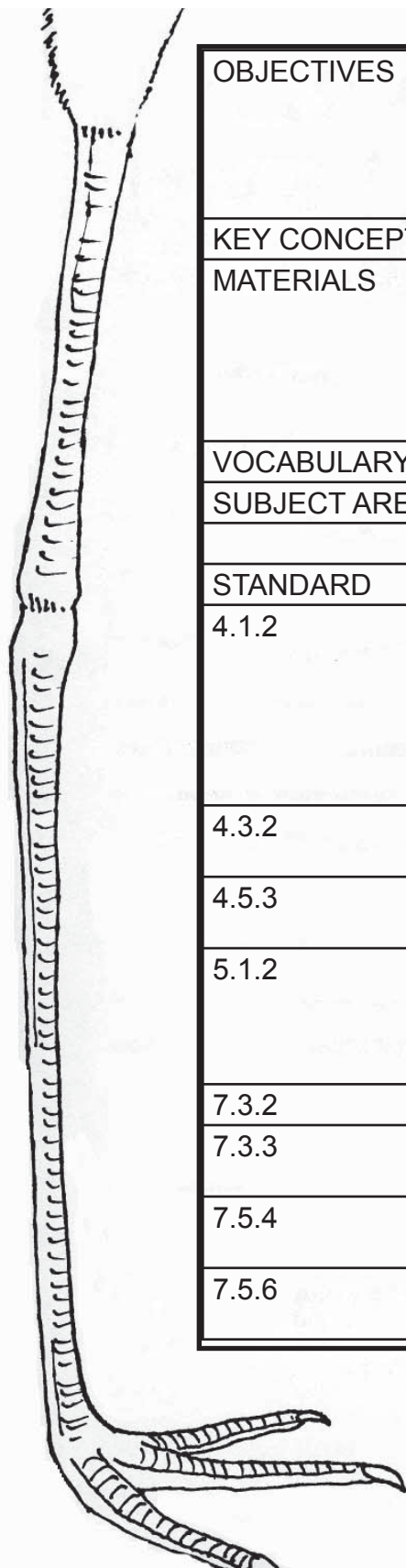
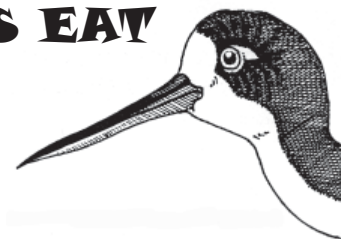


# BILLS AND FEET AND WHAT BIRDS EAT

Grades 4,5,7



OBJECTIVES	Students will use deductive reasoning, observing and writing skills to: <ul style="list-style-type: none"> <li>Observe and describe how birds' bills and feet are adaptations for obtaining food.</li> <li>Compare the advantages of having a bill suited to obtain a specialized diet versus a bill suited to eating a generalized diet .</li> </ul>
KEY CONCEPT	The bills and feet of birds are adapted for obtaining various foods.
MATERIALS	a nutcracker, a straw* or eyedropper, needle-nose pliers, a pair of chopsticks with pointed ends, a few hard-shelled nuts, a beaker of water, a few dried peas or beans, and a couple of tiny dried shrimp [adaptations sheet provided] *DO not use straws in the demonstration if any of the foods are small enough to be inhaled.
VOCABULARY	Adaptation, adaptive radiation, mandible, specialized
SUBJECT AREAS	science, language arts
<b>2005 HAWAI'I STATE CONTENT STANDARDS</b>	
STANDARD	BENCHMARK
4.1.2	Differentiate between an observation and an inference (Sections 4-6: Students should do a bit of research to observe the bird's food(s) of choice and infer why the beak is shaped the way it is. For example – The i'iwi drinks the nectar of 'ōhi'a and tubular flowers. Over time, it has evolved to have a curved beak and it fills a niche other species cannot.)
4.3.2	Describe how an organism's behavior is affected by its environment. (e.g. courting, nesting, feeding patterns) (Section 1)
4.5.3	Describe how different organisms need specific environmental conditions to survive. (Section 6)
5.1.2	Formulate and defend conclusions based on evidence (Sections 4–6. Students can work on the exercises determining bird foot and beak type and how the form and function of these parts correspond to their common environment.)
7.3.2	Explain the interaction and dependence of organisms on one another.
7.3.3	Explain how biotic and abiotic factors affect the carrying capacity and sustainability of an ecosystem.
7.5.4	Analyze how organisms' body structures contribute to their ability to survive and reproduce.
7.5.6	Explain why variation(s) in a species's gene pool contributed to its survival in a constantly changing environment.

**OVERVIEW:** Students play a matching game using simulated beaks to attempt to “eat” a variety of foods. They then match illustrations of birds’ beaks and feet to the birds’ food sources by determining how the bills and feet are adapted for obtaining various foods.

**BACKGROUND:** The bills and feet of birds are adaptations to various habitats. The bills allow different species of birds to obtain particular foods and the feet are adapted for grasping branches or wading in water where the food source is found. It is interesting to note that one of the more common species of Hawaiian honeycreeper, the ‘Amakihi, is the most adaptable. This bird eats insects, nectar, and fruit and frequents rain forests as well as dry māmane-naio forests on Mauna Kea- two widely different habitat types. Most of the Hawaiian birds with highly specialized bills are either rare or extinct. Scientists are not certain how much the overly-specialized bills and specific food needs have contributed to the extinction of these birds, particularly since so many other factors, such as disease, may have contributed to the birds’ demise. Yet, it has been hypothesized that overspecialization in feeding habits and bill structure may have made them more vulnerable to decline following habitat degradation by people.

### PROCEDURE:

1) Ask four students to volunteer to be birds and give each a “beak”. If possible, involve more students by taking turns with the beaks or by providing more beaks for groups of students to use. The beaks, a nutcracker, needle-nose pliers, a straw, and a pair of chopsticks are suited for eating the following foods:

“BEAK”	USED FOR...
nutcracker	Breaking open hard-shelled nuts.
needle-nose pliers	Probing for small insects in bark (Use dried peas or beans to simulate insects.)
straw	Sipping nectar (A beaker of water could simulate nectar.)
pair of chopsticks	Probing for tiny insects or shrimp in the mud (Use tiny dried shrimp.)

2) The volunteer birds should attempt to “eat” the foods and determine which food can be obtained with their beaks.

3) When the birds have found their food source, discuss the suitability of each bill for obtaining food. Which bills are most versatile? For instance, the needle-nose pliers “beak” could eat both the shrimp and the peas or beans. Could it be used to sip nectar? If a bird’s habitat were disturbed, which bird would have a better chance for survival, a bird with a bill suited to only one food source, or a bird with a bill suited to obtaining a variety of foods?

4) Distribute the student activity sheet and ask students to match the bills and feet of the birds to their food source.

5) Discuss their answers and compare the simulated beaks to the actual bills of some of the endangered birds on the student activity sheet.

- The nutcracker could be compared to the palila’s beak, which is used for cracking open māmane seedpods.
- The i’iwi feeds on ‘ōhi’a and lobelia nectar, and the straw could be used to make a very rough comparison; note that it also feeds on insect larvae.
- The Hawaiian Stilt uses its long bill to probe in the mud for its diet, which includes crustaceans. The chopsticks could be compared to its bill.
- The needle-nose pliers could similarly be compared to the bill of the ‘amakihi that is suited to eat-

- ing a variety of foods including insects, nectar, and fruit. Note that the ‘amakihi is not endangered.
- The unusual bill of the ‘akiapōlā‘au is adapted for obtaining insect larvae from trees. The lower part of its bill (the mandible) is used for pecking; the upper mandible is used for probing.

6) Ask students to think about how the feet of each bird might be adapted to suit its environment and feeding habits. The feet of the palila, the i‘iwi, and the ‘amakihi wrap around small branches, which helps to hold the birds in place. The feet of the ‘akiapōlā‘au are adapted to grasping the surface of larger branches which balances the bird as it pecks for food. The feet and long legs of the Hawaiian Stilt are suited to wading in water in search of food. Ask students to imagine some of these birds switching roles. For example, a Stilt perched on a small branch sipping nectar and a palila probing in the mud.

7) The students should take home the activity sheets and compare the adaptations to those they observe in birds in their neighborhoods. They should make a written report of their observations and share them with the class on the following day. What did they notice birds eating? How were the bills and feet suited to obtain these foods?

## EXTENSIONS:

Grade 4:

4.5.3 Explain and give examples of how other organisms need specific environmental conditions to survive.

- 1) Have students pick out three organisms native to Hawai‘i (refer to list from the Comprehensive Wildlife Conservation Strategy- page 27 of this guidebook.)
- 2) Next, students will list for each species environmental conditions the organisms need to survive. Research on the web or in encyclopedias would add to the activity- if time and resources allow. This will help students start to establish fundamental inquiry skills necessary later in school.
- 3) Have students write/present to the class or a peer why different organisms need specific conditions for survival.

Grade 5:

5.1.2 Formulate and defend conclusions based on evidence.

- 1) Have students pick one bird that is on the poster but was not explained in detail in class.
- 2) Students should, using what they’ve learned, note the reasons why this bird has the beak and feet they do. Students should answer what environmental conditions could have possibly contributed to the evolution of the chosen bird’s beak and foot type. Teacher’s example: Pueo. This bird is a raptor, or a bird of prey. Their attributes include a beak that is sturdy with a pointed tip. This helps them feed on the rodents they catch. The tip is narrow which helps them gather insects. Their feet and toes are separated with long talons, which aid in catching and holding live prey as well as holding onto branches of trees.

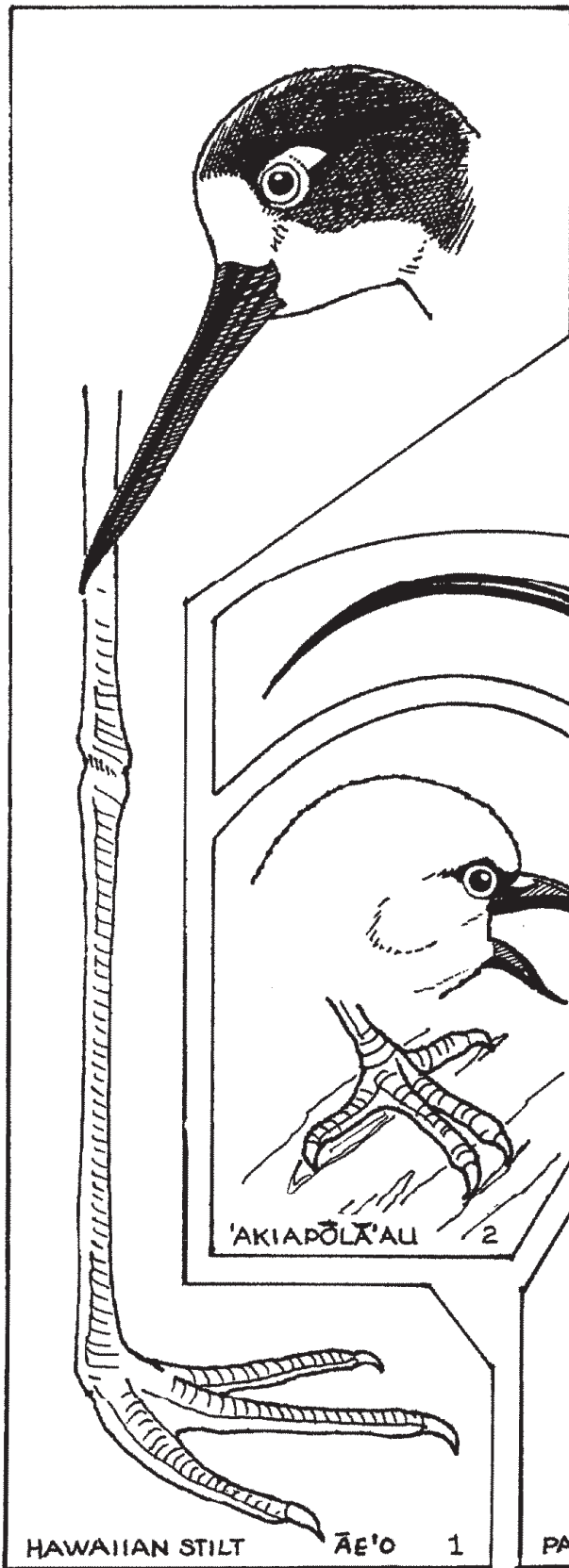
Grade 7:

7.5.4: Analyze how organisms’ body structures contribute to their ability to survive and reproduce.

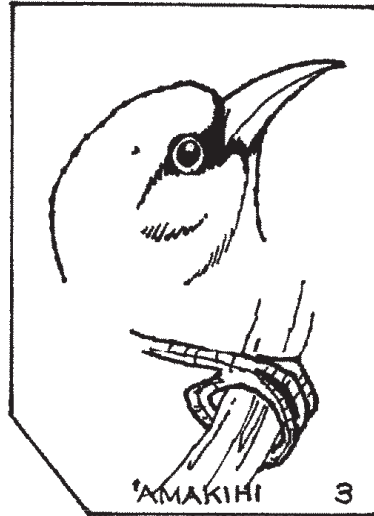
- 1) Have students research the term adaptive radiation and apply it to Hawaiian honeycreepers in a sentence.
- 2) After discussing the proper definition of adaptive radiation, students should write a paragraph on the following: If the honeycreepers are all from a common ancestor, why have they developed specialized beaks? Select one of the five groups found in “If unique is what you seek” and explain why and how their beaks have adapted to accommodate their food choice.

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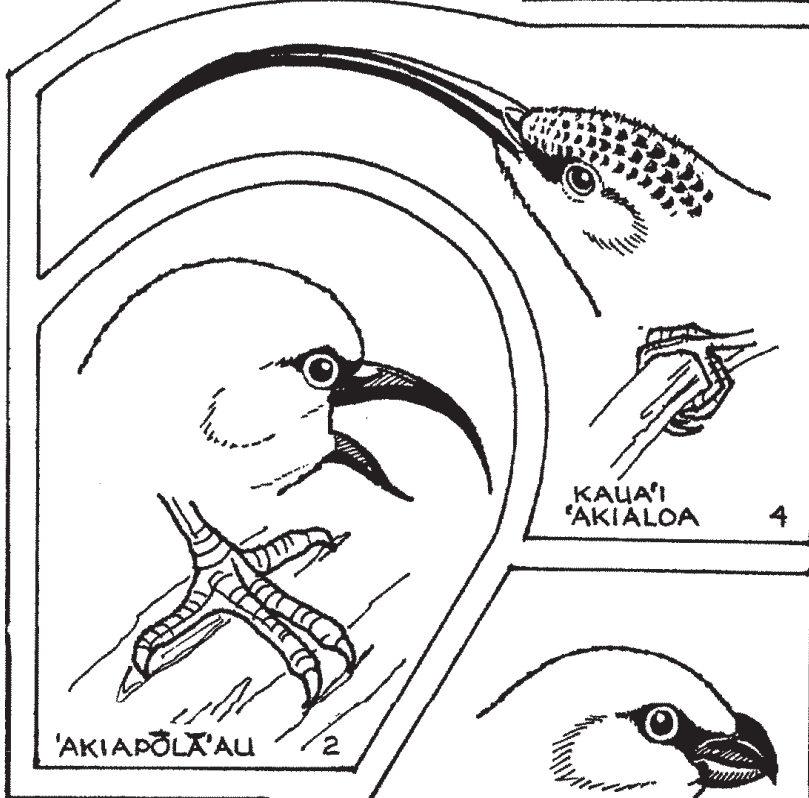
## Activity Handout



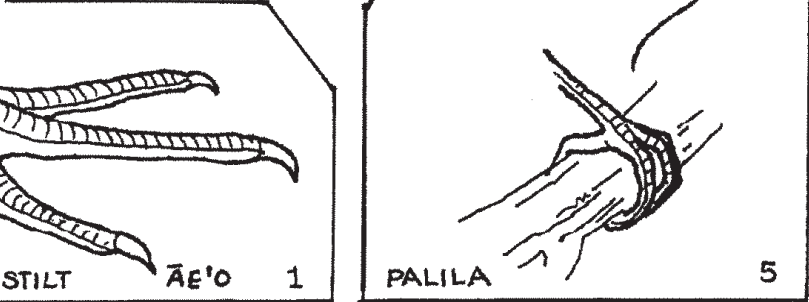
HAWAIIAN STILT Āe'o 1



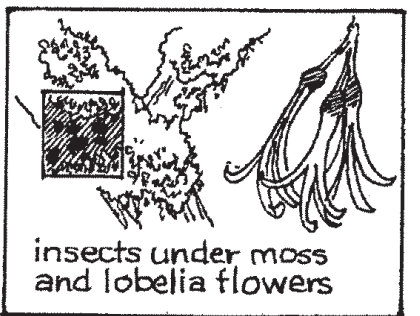
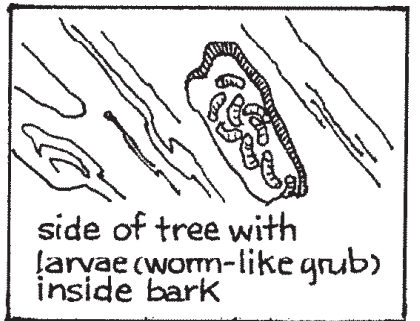
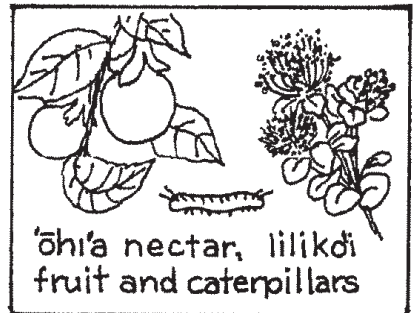
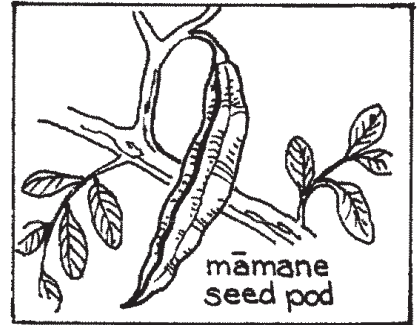
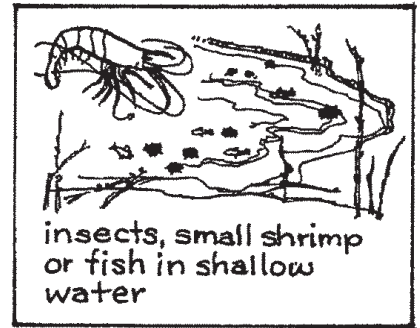
'AMAKIHI 3



'KAUAI' AKIALOA 4



PALILA 5



**INSTRUCTIONS:** Look at the bills and feet of each bird to find clues as to what it eats. Then draw a line from each bird to its food.